BEYOND THE TANKS
THE UNSEEN BACKBONE OF RAS SUCCESS

Insights from a written exchange with Marianne Naess, CEO of Great Northern Salmon – a developer specialising in RAS for Atlantic Salmon in the USA.

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As the land-based salmon farming sector matures, the conversation is shifting from the promise of technology to the pragmatics of execution. While RAS (Recirculating Aquaculture Systems) technology is often the headline, industry leaders are emphasising that success hinges on a less visible, but far more critical, factor: integrated, front-end planning.

According to Great Northern Salmon (GNS), a developer of land-based Atlantic Salmon farms in the USA, the predominant challenge facing new projects is not typically technical failure, but "insufficient upfront planning" that cascades into both flawed designs and operational bottlenecks. "This expertise must be well established in-house because the producer must be in the 'driver's seat,'" Marianne Naess, CEO of GNS, notes. "From there, the producer and vendors can have productive conversations about how best to address requirements."

Laying the biological foundation

At its core, successful commercial-scale RAS salmon farming depends on creating stable, optimal conditions for the fish. GNS emphasises three non-negotiable pillars: impeccable water quality, robust bio-planning that accounts for natural biological variability and precision logistics for production flow.

"Many RAS companies have set overly ambitious goals and failed to meet biomass targets," Marianne cautions, highlighting the importance of realistic density targets and growth curves. This biological realism must inform every aspect of design. The entire system configuration, she argues, must be based on "realistic production assumptions." For instance, planning all fish movements in detail is crucial to avoid bottlenecks in tank layouts – a problem that is difficult and expensive to rectify once the facility is built.

The smolt strategy

One of the most significant leverage points for risk mitigation is control over the early life stages. GNS identifies smolt strategy as having a "very large impact" on long-term operations. Externally sourcing smolt introduces substantial biosecurity risks; "one can disinfect an egg, but not a fish," Marianne points out. Furthermore, the quality, size and timing of smolt supply must align perfectly with grow-out plans. Misalignment can lead to missed biomass targets and systemic inefficiencies.

To manage this, she advocates for controlling the smolt supply chain. Their own design incorporates redundancy in early-stage units to accommodate variable growth rates—a flexibility that is "often very difficult to [achieve] in the grow-out phase" without causing density issues or cohort conflicts.

Designing for reality, not idealism

The quest for scalability and modular expansion, often touted as a benefit of RAS, requires careful scrutiny. GNS presents a contrarian view: "Larger RAS facilities are less scalable than one would wish." Marianne explains that phasing a facility incrementally while maintaining optimal, disruption-free production flows is immensely complex. "It is a clear misconception that these facilities can grow module by module while operating at optimal capacity."

Instead, she advocates for identifying a "sweet spot" in scale – large enough to achieve basic economies of scale, ensure consistent supply to buyers and support a viable value chain, but not so large that complexity becomes unmanageable. For early-stage projects, starting too small can cripple financials unless unrealistically high price premiums are assumed, while scaling up later is disruptive and costly.

System robustness is, of course, paramount, and selecting a vendor with a proven track record is key. However, engineering must be guided by operational reality. "Production planning has often been too superficial," the CEO observes, "which can lead to problems in design and operations that are hard to fix once in operation."

The uncompromising need for ideal conditions

A recurring theme in GNS's philosophy is the refusal to compromise on the biological needs of Atlantic Salmon, particularly regarding temperature. "Salmon ideally should be kept at around 12°C year-round," Marianne states. Deviations from this ideal can lead to fish stress, high early maturation rates,

reduced product quality and severe welfare issues. This has direct implications for site selection and energy strategy.

Locating a farm in a climate that naturally aligns with the species' needs is the first step to minimising excessive energy use for heating or cooling. The source of that energy is equally critical for sustainability claims. "RAS facilities built close to the markets are often presented as the more environmentally friendly solution. We would argue that the surrounding climate conditions and a high degree of clean power sources are also important to be able to make that claim," she adds.

The human factor

While a wide array of SCADA, monitoring and even AI-driven decision-support tools are available, GNS places paramount importance on human expertise. "One of the most valuable monitoring tools still available is having experienced fish farmers' eyes on the tanks and the fish every day of the week," Marianne asserts. AI can optimise feeding, and sensors can monitor water parameters, but manual testing for compounds like geosmin and pathogens remains essential for risk mitigation.

Crucially, a farm must be designed to be operated manually if necessary. Over-reliance on automation without the depth of operational experience to back it up is a significant risk. "A farm should also be built to be operated manually if needed, to minimise the effects of potential system or technical failures."

Navigating the US landscape

In the United States, site selection is an exercise in thorough due diligence that goes far beyond finding an empty plot of land. GNS warns that underestimating site challenges has derailed numerous projects. "A site without a robust connecting infrastructure can result in significant CAPEX/OPEX impacts, in some cases exceeding 15-20 percent of total CAPEX," Marianne notes, citing power and water infrastructure needs.

Regulatory and legal landscapes vary dramatically by state. Understanding environmental standards, fish health regulations and, critically, the legal frameworks for permit appeals and litigation is vital. "There are many cases in the US where projects have been held up in court for significant periods of time, which, in many instances, have killed them." Therefore, finding a community open to development is a non-negotiable risk mitigant.

The path forward: experience over gadgets

Looking ahead, GNS sees incremental innovation rather than revolution. The "holy grail" would be technology that eliminates the geosmin purge phase, significantly boosting water efficiency. Further AI development will continue. However, Marianne believes the most critical "innovation" is often overlooked: the quality of the development team.

"The quality of the development team and their hands-on experience in planning and execution are the most important factors for farm success," she concludes. This expertise must span executive strategy, production planning, design, construction management and hands-on RAS operations. "All are needed in-house to achieve a well-performing farm. Investors must hold companies to that standard."

Ultimately, the future of reliable, cost-efficient and scalable land-based salmon farming may depend less on the next breakthrough in filter technology and more on the rigorous, integrated planning that happens long before the first tank is ever installed.